

REMARKS

The Applicants have carefully considered this application in connection with the Examiner's Office Action and respectfully request reconsideration of this application in view of the following remarks. In the present response no Claims have been amended, and accordingly, Claims 1, 4-12 and 15-24 are currently pending in the application.

I. Rejection of Claims 1, 4-12, 15- 24 under 35 U.S.C. §103

The Examiner has rejected Claims 1, 5-12, and 16-24 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 5,591,671 to Kim *et al.* ("Kim") in view of U.S. Patent No. 5,714,418 to Bai *et al.* ("Bai") and U.S. Patent No. 5,970,374 to Teo ("Teo"). The Examiner further rejected Claims 4 and 15 under 35 U.S.C. §103(a) as being unpatentable over Kim in view of Bai and further in view of the Applicant's admitted prior art ("AAPA"). The Applicants respectfully disagree.

The combination of Kim in view of Bai and Teo fails to teach or suggest all elements of the claimed inventions and thus fails to establish a *prima facie* case of obviousness. For instance, this combination of references do not teach or suggest subjecting the contact plug within the contact opening to a temperature from about 600°C to about 750°C to anneal the barrier layer in the contact opening, as recited in Claim 1 and other independent claims.

Kim is concerned with preventing oxidation of his ohmic contact (e.g. Ti) and barrier (e.g., TiN) layers when heated at a temperature of about 500°C because this deteriorates their contact resistance (Column 2, Lines 8-22). To reduce oxidation, Kim deposits the refractory metal layer 28 on the whole surface of the structure shown in FIGURE 2D and then heats the resultant structure

shown in FIGURE 2E at a temperature above 450°C, and more preferably 500°-550°C (Column 4, Lines 57-64). Kim does not disclose or suggest heating beyond 550°C (*see e.g.*, Column 6, Lines 4-30 and FIGURE 5).

In contrast, Teo performs rapid thermal annealing (RTA) at 670°C after the deposition of a Ti layer 16 and a TiW layer 18 (Column 4, Lines 17-25; FIG. 3A), but *before* the deposition of tungsten 40 (Column 5, Lines 3-8; FIGURE 3E). Thus Teo's RTA is conducted at a much earlier point in the fabrication process than the heating step used in Kim's process.

The Applicants maintain that there is no motive for one skilled in the art to apply Teo's RTA of 670°C to the heating stage in Kim's process. The Examiner seeks to use Teo's statement that RTA activates the carriers in the silicon and forms strong chemical bonds to the Ti as the motive for inserting Teo's RTA into Kim's process. Kim, however, is trying to balance the benefits of heating above 450°C to improve the interconnection properties of the ohmic contact and barrier layers (Column 1, Lines 60-62), against severe oxidation of these layers at temperatures above 500°C (Column 2, Lines 13-22). Even with his refractory metal layer 28 in place, however, Kim is careful not to heat beyond 550°C. There is no reason why one skilled in the art would be motivated to heat Kim's ohmic contact and barrier layers beyond Kim's limit of 550°C, based on Teo's teaching of performing a RTA of Ti and TiW layers in the unfilled contact opening 15 shown in Teo's FIGURE 3A. Moreover, because Teo's RTA is conducted at a different point in the fabrication process than Kim's heating step, one skilled in the art would be extremely reluctant to changes Kim's heating step to Teo's RTA. As the Examiner is well aware, introducing process variables into a process flow can have unpredictable consequences and therefore changes in a process flow are not done without a strong motive to do so. Given that Kim teaches or suggestions temperatures up to 550°C, one skilled

in the art would not have sufficient motive to change the heating step to 600°C and beyond. The Applicants respectfully submit that the Examiner is improperly using hindsight reconstruction to pick and choose among isolated disclosures from Kim and Teo to deprecate the claimed invention.

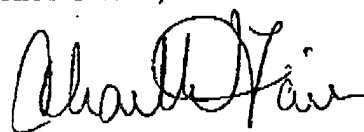
In summary, the combined teachings of Kim in view of Bai and Teo do not teach or suggest all elements of the present invention and are not properly combinable. This combination of references, therefore, fails to establish a *prima facie* case of obviousness with respect to independent Claim 1, as well as independent Claims 12 and 24, which contain analogous elements as Claim 1, or their respective dependent claims, under 35 U.S.C. §103(a). The Applicants therefore respectfully request the Examiner withdraw his rejection and allow Claims 1, 4-12, and 15-24.

II. Conclusion

In view of the foregoing remarks, the Applicants now see all of the Claims currently pending in this application to be in condition for allowance and therefore earnestly solicit a timely Notice of Allowance for Claims 1, 4-12 and 15-24.

The Applicants request the Examiner to telephone the undersigned attorney of record at (972) 480-8800 if such would further or expedite the prosecution of the present application.

Respectfully submitted,
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